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EAST EUROPE REPORT

SCIENCE & TECHNOLOGY

CONTENTS

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SELECTIONS ON CSSR ELECTRONICS, COMPUTER TECHNOLOGY

MHB8804 Integrated Circuit

Prague SDELOVACI TECHNIKA in Slovak No 4, 1984 p 125

[Article by Eng Peter Volf: "Properties of the MHB8804 Integrated Circuit and Its Applications"]

> [Excerpt] The described circuit is a digital-analog switch designed primarily for switching purposes in new electronic exchanges produced under license in Tesla Liptovsky Hradok. In view of the wider possibilities for its applications that go beyond its use restricted to switching fields of electronic exchanges only, the objective of this article is to familiarize the public with the properties and applications of the MHB8804 circuit.

Description of MHB8804 Circuit

The 8804 circuit is a LSI circuit produced by CMOS technology and is housed in a 24-outlet DIL casing.

It consists of two parts:

a) a digital part, which forms the switching control and memory;

b) an 8 x 4 analog switching field consisting of 32 switching transistors.

The digital part is formed by the 1 z 8 decoder with three addressing and one selective input and eight 4-bit registers with common clearance to zero setting. The registers are connected in parallel to the individual data inputs of the data busbar. Each output from the register controls one of the switching transistors in the switching field which form the analog switching part of the circuit. The switching field has four input/outputs bearing the designation J and eight input/outputs designated L.

Logic no 1 on the output of the register means that the corresponding transistor is conductive and the points of the switching field JX and LY are

connected. The impedance between these input/outputs is approximately 100 ohms. Logic zero at the register's output causes the transistor between points JX and LY to become nonconductive and the connection has a very high impedance--from tens to hundreds of megaohms.

Switching Procedure in the Switching Field

The MHB8804 circuit can be functionally visualized as 4 8-position switches that make it possible to connect each input/output J sequentially to one of the input/outputs L and store each connection in the memory. The method for control of the switching field is given by the diagram in Figure 1 and in Truth Tables 1 and 2.

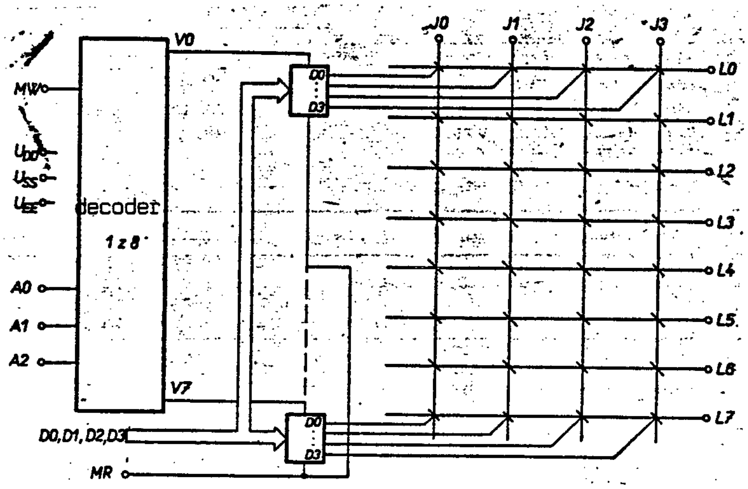

Figure 1. Schematic Wiring Diagram

Inputs						Inputs/Outputs							
A0	A1	A2	MW	MR	JX	L0	L1	L2	L3	L4	L5	L6	L7
X	X	X	L	L		Disconnected unchanged							
X	X	X	X	H									
L	L	L	H	L	SEE TAB 2	+							
H	L	L	H	L			+						
L	H	L	H	L				+					
H	H	L	H	L					+				
L	L	H	H	L						+			
H	L	H	H	L							+		
L	H	H	H	L								+	
H	H	H	H	L									+

Table 1. Truth Table

x = state is immaterial
\+ = selected connection
L = state log. 0
H = state log. 1

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
D0	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H
D1	L	L	H	H	L	L	H	H	L	L	H	H	L	L	H	H
D2	L	L	L	L	H	H	H	H	L	L	L	L	H	H	H	H
D3	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H
J0	Disconnected	+		+		+		+		+		+		+		+
J1			+	+			+	+			+	+			+	+
J2					+	+	+	+					+	+	+	+
J3									+	+	+	+	+	+	+	+

Table 2. Truth Table

\+ = selected connection
L = state log. 0
H = state log. 1

By adjusting the combinations of logic 0 and 1 on address conductors A0, A1 and A2 we select the desired register corresponding to one of the outputs. By setting log. 1 on one or all four data bits D0, D1, D2 and D3 we select one to four of the transistors we want to connect. The state of the data busbar is transcribed onto the selected register by means of a positive pulse on circuit selection MW. Four 0 or one to four log. 1 can be entered into the register. Depending on the former, all four input/outputs J are disconnected (from the L determined by addresses), or one to all four J are connected to the output.

The principle of its operation makes it possible to switch simultaneously--after one pulse on circuit selection MW--one to four input/outputs J to one of the input/outputs L and thus, after eight address settings, data and eight pulses on the circuit's output it is possible to interconnect all the J and L. On the other hand, they can all be sequentially disconnected by log. 0 entries into the registers. Such sequential disconnecting makes sense only during partial disconnection. Input MR serves for disconnecting all of the connections. When log. 1 is fed to the mentioned input, all connecting points become disconnected.

In a case when log. 1 is permanently on the circuit selection MW, individual connections are connected and disconnected by changes in address and data. However, if we want to change both addresses and data and input of MW is in log. 1, then we risk uncontrollable transcription of registers and, consequently, connecting and disconnecting.

Z800 Microprocessor

Prague SDELOVACI TECHNIKA In Czech No 4, 1984 p 128

[Text] After the 16-bit microprocessor Z800 [3], the new series of 8/16 bit microprocessors Z8000 represents the most important production series. (Rep. note: the Zilog company produces microprocessors in series Z8, Z80, Z800 and Z8000.)

The Z800 series can be considered as a "Z80 superseries," not only because of its fivefold speed, but also because of its highest functional complexity per chip. The Z800 series comprises two types with an 8-bit and two types with a 16-bit busbar, thus warranting its compatibility with the busbars of the Z80 as well as the 16-bit busbars turned out by Zilog.

In addition to its full code compatibility with the Z80, the Z800 expands the set of instructions by many additional commands. The speed of carrying out of commands is 1 to 5 million instructions per second. Moreover, the following functions are integrated on a chip: the MMU memory handling unit, support of virtual memories, DMA, counter and cycle generator, UART, memory restoration and a 256 byte buffer memory. It is this buffer memory that makes it possible to increase the speed of the CPU [central processing unit] vis-a-vis memory. The CPU operates two to four times faster than the busbar. In view of this

property, the fast CPU can be built into already existing microprocessor systems without requiring any changes in the structure of memories or peripheral circuits.

The compatibility of the Z800 instructional set with the Z80 is better than was that of the Z80 with 8080. For example, indicative bits are defined the same way as in the case of the Z80. Since, according to Zilog's data, the Z80 series covers approxiamtely 25 percent of the worldwide production of 8-bit microprocessors, there exists a large number of programs for the Z80. Many firms (specializing in the generation of software) have come up with a host of programs in Z80 machine code (assembler) while for years they have had none of the original documentation at their disposal and possible errors are corrected in various ways, "doctored." All these programs can now be used also with Z800 series hardware.

Development from Z80 to Z800.

The Z80 microprocessor has been in production since 1976 and its original version with cycling frequency of 2 MHz [megahertz] and chip edge dimensions of 5 mm was accelerated through gradual refining of structure and reducing of chip size up to cycle frequency of 8 MHz (Rep. note: in steps 2, 5, 4, 6 and 8 MHz [2]). Nevertheless, this procedure cannot be continued indefinitely and it is also not possible to improve all properties at the same time. For example, individual chronological relations are less and less mutually adapted with the continuously diminishing structure. Thus, at a certain level, it becomes necessary to come up with a new chip that would reflect the latest findings made in semiconductor technology. Of particular importance to obtaining a fast CPU is revamping of the time behavior of control signals. A revised CPU, particularly with optimized time behavior, can be integrated into the entire system more easily.

The ever-increasing demands on the performance of the Z80 series, particularly with regard to operational speed, led to the development of a new microprocessor. The first samples of the new Z800 series have a cycle frequency of 10 MHz and their serial production should start in early 1984, to be followed later by a version with 18 MHz and in about 2.5 years by a version with 25 MHz.

The memory handling unit on the chip expands the extent of memory addressing to 16 megabytes in page arrangement, whereby pages are displayed in the memory's physical region. This technique is also used in minicomputers. The memory handling unit also supports virtual memory systems, whereby it rejects instructions when the specified data are not comtained in the main memory.

A special register on the Z800 chip controls the relation between the CPU's cycle frequency and the timing cycle of the busbar and makes it possible to operate the CPU at two to four times the speed of the busbar. The latter, naturally, can be accomplished only with the aid of a buffer memory, also integrated on a chip.

New Commands

Among the new commands which the Z800 has over the Z80 belong particularly hardware-performed multiplication and division, 16-bit arithmetic, transmission of 16 bitlong words, retrieval of systemic commands as well as testing and adjusting commands for multiprocessor operation.

Other commands facilitate cooperation with coprocessors compatible with Zilog's architecture of "extended processing." An example of this is the Z8070 processor for computations with a floating decimal point. This also involved the introduction of new types of addressing, and registers IX and IY of the Z80 microprocessor were divided into two register pairs, increasing the possibilities for programming.

Microprocessors of the Z800 series can cooperate with systems of either the Z80 or the Z8000 series. CPU's of the types Z8108 and Z8208 are designed for small systems (suitable for nonmultiplexed Z80 busbar) capable of working with peripheral 8-bit units designed originally for the Z80, or with 16-bit units of the Z8500 series.

The Z8116 and Z8216 operate with a 16-bit multiplexed busbar originally developed for microprocessors of the Z8000 series and can be connected to peripheral units of the Z8000 series with a 16-bit busbar.

The Z8108, Z8116 and Z8118 come encased in a 40-outlet casing with 19 out of 24 potential address lines led out. There is no access to internal peripheral units from outside.

The Z8208 and Z8216 come in casing with 64 outlets and in addition to all of the 24 addressing lines they have additional outlets for peripheral units on the chip which can thus be switched on and off. The spacing of outlets in casings of the Z800 series is approximately 1.8 mm, so that casings with 64 outlets are no bigger than the usual casings with 48 outlets of the standard DIL series of casings.

Conclusion

The tempestuous development of electronics over the last several years continues in the case of microprocessors and microprocessor systems. After the 8080 industrial standard came the improved Z80, which is now followed by the latest Z800. The viable set of the 8080 microprocessor produced in our country has been developmentally expanded by the Z80 equivalent produced in CEMA countries (U880D, GDR).

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Sequential CMOS Circuits

Prague SDELOVACI TECHNIKA in Czech No 4, 1984 pp 133-136

[Article by Jaroslav Kruml, data technician: "Sequential Unipolar Integrated CMOS Circuits"]

[Excerpts] This article follows up on the preceding one published in SDELOVACI TECHNIKA No 10/83 and will deal with unipolar sequential CMOS circuits. To the latter apply the same limiting values of electric properties, basic static specifications and recommended specifications listed in the mentioned article in this periodical. Many sequential circuits are currently represented by the MHB 4006, MHB4013, MHB4015, MHB4020, MHB4024, MHB4029, MHB4035, MHB4076, MHB4099, MHB4515 and MHB4555 circuits. At the same time, the operational temperature range of all unipolar CMOS circuits was increased to -40°C through 85°C. The operational load of 500 mW [milliwatts] on the casing must not be applied at ambient temperatures in excess of 60°C, but only by the output read off from the graph shown in Figure 1. This article offers a detailed description of circuits MHB400 through MHB4029.

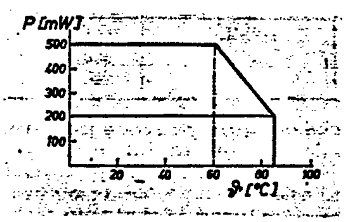

Figure 1. Load capacity of casing in mW in dependence on ambient temperature

Description and Characteristics of Sequential Circuits

The MHB4006 circuit is an 18-bit sliding static register which consists of four independent sections with independent inputs and outputs and a common time input. The first 2 sections are 4-bit, the next two sections are 5-bit with a branch on the fourth bit. Data are advanced to the next position by the trailing edge of the time pulse. The wiring diagram is shown in Figure 2 and connection of casing outlets appears in Figure 3 [not reproduced]. The supplementary basic static characteristics of the circuit are shown in Table 1 and the circuit's basic dynamic characteristics are listed in Table 2. Time behavior definitions are shown in Figure 4 [not reproduced]. The circuit was prepared by CMOS technology and encased in a 14-outlet DIL casing.

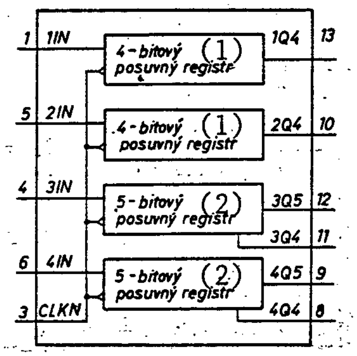

Figure 2. Wiring diagram of the MHB4006 circuit

Key: (1) 4-bit sliding register
(2) 5-bit sliding register

Table 1. Supplementary basic static characteristics (spacing feed current I_{DD}; θ_a = 25°C, U_{SS} = 0 V)

Circuit	Designat.	U_{DD} [V]	Unit	Min.	Max.	Remark
MHB4006	I_{DD}	5 10 15	µA µA		10 20 100	1)
MHB4014	I_{DD}	5 10 15	µA µA		10 20 250	1)
MHB4015	I_{DD}	5 10 15	µA		50 100 200	1)
MHB4020 MHB4024	I_{DD}	5 10 15	µA		50 100 500	1)
MHB4029	I_{DD}	5 10 15	µA		50 100 500	1)

1) Inputs connected to U_{SS} or U_{DD} [applies to all tables following]

Table 2. Basic dynamic characteristics of circuit MHB4006

(δ_a = 25°C; CL = 50 pF; t_r, t_j = 20 ns; U_{SS} = 0 V)

Characteristic	Designation	U_{DD} [V]	Units	Value min.	Value max.	Remark
zpoždění výstupu *Qn* proti hod. impulsu *CLKN* (1)	t_{pHL} t_{pLH}	5 10 15	ns		500 250 200	1)
vzrůst a sestup výstupního impulsu (2)	t_r t_f	5 10 15	ns		400 200 150	1)
šířka hodinového impulsu (3)	t_{WCLK}	5 10 15	ns	400 200 100		1)
týl hod. impulsu (4)	t_f	5 10 15	ns		15 000 5 000 5 000	1)
předstih dat před hod. impulsem (5)	t_{su}	5 10 15	ns	100 50 40		1)
přesah dat za hod. impulsem (6)	t_{hold}	5 10 15	ns	200 100 80		1)
kapacita vstupu dat *IN* (7)	IN_{CL}	5 10 15	pF		5	
kapacita vstupu hod. impulsu *CLKN* (8)	$CLKN_{CL}$	5 10 15	pF		30	

Key: (1) Output delay Qn against time pulse CLKN
(2) Rise and fall of output pulse
(3) Time pulse width
(4) Trailing edge of time pulse
(5) Data lead over time pulse
(6) Data overlap behind time pulse
(7) Data input capacity IN
(8) Time pulse CLKN input capacity

Table 3. Basic dynamic characteristics of MHB4013
(δ_a = 25°C; CL = 50 pF; r_r, t_j = 20 ns; U_{SS} = 0 V)

Characteristic	Design	U_{DD} [V]	Unit	Min.	Max.	Remark
spoždění výstupu dat proti hodinovému impulsu CLK (1)	t_{pHL} t_{pLH}	5 10 15	ns		380 200 120	1)
šířka hodinového impulsu H i L (2)	t_{WCLK}	5 10 15	ns	200 100 80		1)
čelo a týl hrana hodinového impulsu (3)	t_r t_f	5 10 15	μs		15 10 5	1)
předstih vstupních dat před hodinovým impulsem (4)	t_{su}	5 10 15	ns	100 50 25		1)
spoždění výstupu dat proti vstupu R nebo S (5)	t_{pHL} t_{pLH}	5 10 15	ns		400 170 100	1)
šířka vstupního impulsu R a S (6)	t_{WH}	5 10 15	ns	400 200 100		1)
zotavovací doba po nulování nebo nastavení (7)	t_{RMR}	5 10 15	ns	80 50 50		1)
časový průběh čela a týlu výstupního impulsu (8)	t_r t_f	5 10 15	ns		300 200 100	1)

Key: (1) Data output delay against clock pulse CLK
(2) Clock pulse width H and L
(3) Leading and trailing edge of clock pulse
(4) Input data lead over clock pulse
(5) Data output delay against input R or S
(6) Width of input pulse R and S
(7) Recovery time after erasing or zero setting
(8) Time behavior of the leading and trailing edges of output pulse

Table 4. Basic dynamic characteristics of MHB4015 circuit
(δ_a = 25°C; CL = 50 pF; r_r, t_j = 20 ns)

Characteristic	Design.	U_{DD} [V]	Unit	Value min.	Value max.	Remark
přenosové spoždění CLK Qn (1)	t_{pLH} t_{pHL}	5 10 15	ns		320 160 120	1)
přenosové spoždění R Qn (2)	t_{pHL}	5 10 15	ns		400 200 160	
časový průběh čela a týlu výstupu (3)	t_r t_f	5 10 15	ns		200 100 80	
předstih dat před hodinovým impulsem (4)	t_{su}	5 10 15	ns	100 40 30		
přesah dat za hodinovým impulsem (5)	t_{hold}	5 10 15	ns	40 20 15		
šířka hodinového impulsu CLK (6)	t_{WL}	5 10 15	ns	180 80 50		
šířka nulovacího impulsu R (7)	t_{WH}	5 10 15	ns	200 80 60		
zotavovací čas po nulování vzhledem k CLK (8)	t_{zot}	5 10 15	ns	150 100 70		

Key: (1) Transmission delay CLK Qn
(2) Transmission delay R Qn
(3) Time behavior of output's leading and trailing edge
(4) Data lead over clock pulse
(5) Data overlap behind clock pulse
(6) Width of clock pulse CLK
(7) Width of zero-setting pulse R
(8) Recovery time after zero setting in relation to CLK

Table 5. Basic dynamic characteristics of circuits MHB4020 and MHB4024

(δ_a = 25°C; CL = 50 pF; T_r, t_j = 20 ns; U_{SS} = 0 V)

Characteristic	Design.	U_{DD} [V]	Unit	Value min.	Value max.	Remark
zpoždění výstupu *Q1* proti vstupu *CLK* (1)	t_{pHL} t_{pLH}	5 10 5 1	ns		450 250 230	1)
časový průběh čela a týlu výstupního impulsu (2)	t_r t_f	5 10 15	ns		300 250 200	1)
šířka vstupního hodinového impulsu *CLK* (3)	t_{WH} t_{WL}	5 10 15	ns	200 100 80		1)
zpoždění výstupu proti nulovacímu impulsu *R* (4)	t_{pHL}	5 10 15	ns		450 250 230	1)
šířka nulovacího impulsu *R* (5)	t_{WR}	5 10 15	ns	350 150 120		1)
zotavovací doba po nulování (6)	t_{RMR}	5 10 15	ns	520 210 160		1)

Key:
(1) Delay of input Q1 against CLK input
(2) Time behavior of leading and training edge of output pulse
(3) Width of input clock pulse CLK
(4) Output delay against zero setting pulse R
(5) Width of zero setting pulse R
(6) Recovery time after zero setting

Table 6. Basic dynamic characteristics of MHB4029 circuit
(δ_a = 25°C; r_r, t_j = 20 ns; CL = 50 pF; U_{SS} = 0 V)

Characteristic	Design.	U_{DD} [V]	Unit	Value min.	Value max.	Remark
spoždění výstupu *Q1* proti hodinovému impulsu *CLK* (1)	t_{pHL} t_{pLH}	5 10 15	ns		900 460 400	1)
zpoždění výstupu přenosu *CY* proti hodinovému impulsu *CLK* (2)	t_{pHL} t_{pLH}	5 10 15	ns		900 460 400	1)
zpoždění výstupního signálu *Qn* proti vstupu *PL* (3)	t_{pHL} t_{pLH}	5 10 15	ns		900 460 400	1)
zpoždění výstupu přenosu *CY* proti vstupu blokování čítání *EN* (4)	t_{pHL} t_{pLH}	5 10 15	ns		700 350 300	1)
časový průběh čela a týlu výstupního impulsu (5)	t_r t_f	5 10 15	ns		200 100 80	1)
šířka hodinového impulsu *CLK* úroveň L (6)	t_{WCLK}	5 10 15	ns	180 100 90		1)
šířka impulsu pro nastavení *PL* (7)	t_{WL}	5 10 15	ns	130 80 60		1)
zotavovací čas po zrušení nastavení *PL* (8)	t_{RMR}	5 10 15	ns	200 110 100		1)
předstih vstupních impulsů *BD* a *UD* proti hod. impulsu *CLK* (9)	t_{su}	5 10 15	ns	340 140 100		1)
předstih vstupního impulsu *EN* před hod. impulsem *CLK* (10)	t_{su}	5 10 15	ns	70 40 20		1)
předstih dat na *IN* před nastavovacím impulsem *PL* (11)	t_{su}	5 10 15	ns	70 40 20		1)
přesah vstupních impulsů *BD* a *UD* proti hod. impulsu *CLK* (12)	t_{hold}	5 10 15	ns	45 20 10		1)
přesah vstupního impulsu *EN* proti hod. impulsu *CLK* (13)	t_{hold}	5 10 15	ns	30 10 5		1)
přesah dat *IN* proti nastavovacímu impulsu *PL* (14)	t_{hold}	5 10 15	ns	30 10 5		1)

Key:
(1) Output Q1 delay against clock pulse CLK
(2) Delay of CY transmission output against clock pulse CLK
(3) Output signal Qn delay against PL input
(4) Delay of CY transmission output against input of EN blocking of counting
(5) Time behavior of leading and trailing edge of output pulse
(6) Width of clock pulse CLK level L
(7) Setting-pulse width PL
(8) Recovery time after setting cancellation PL
(9) Lead of input pulses BD and UD against clock pulse CLK
(10) Lead of input pulse EN over clock pulse CLK
(11) Data lead at IN over setting pulse PL
(12) Overlap of input pulses ED and UD against clock pulse CLK
(13) Overlap of input pulse EN against clock pulse CLK
(14) Overlap of data IN against setting pulse PL

Connectors Production and Optoelectronic Exposition

Prague SDELOVACI TECHNIKA in Czech No 4, 1984 p 141

[Text] The Electronic Structual Elements Combine in Teltow launched production of a new system of connectors for instruments and plug-in modules. It involves multipole receptacles and plugs that meet the requirement on serial connectors of five different dimensions according to IEC recommendation 48 B 126. In so doing the new system also meets all demands placed on multipole connectors abroad. The connectors come equipped with a trapezoidal metal cover which serves as a mechanical protection of the contacts and, at the same time, provides for correct polarization and electric shielding. The production assortment in the GDR will include 9-, 15-, 25-, 37-, and 50-pole receptacles and plugs designed for routine soldering and pressed joints, e.g., soldering of plates with printed circuits.

* * *

The international exposition Laser 83/Optoelectronics which took place from 27 June to 1 July 1983 was participaed in by 195 exhibitors from all over the world. Exhibits offered from among the socialist countries came from Abadimport (Hungarian Academy of Sciences), MOM (Hungarian Optical Enterprises) from Hungary and ISKRA Ljubljana, Yugoslavia. Only 164 enterprises offered exhibits in 1981. More than half of the exhibitors came from abroad, primarily from Belgium, Canada, France, Sweden and the United States.

New 1983 Semiconductor Products

Prague SDELOVACI TECHNIKA in Czech No 4, 1984 p 142

[Excerpt] Intelligent luminous image-forming display units which form complete symbols from simple signals are available on the market in great numbers. All types come equipped with a plastic casing which, while inexpensive, shows little resistance to freezing weather, heat, humidity or nonstandard pressure. The MDL 2416-B display unit (Figure 1) is hermetically sealed in a metal casing covered with silica glass to limit the effects of humidity. Both of the materials are strong enough to protect the unit against mechanical effects. This protection mechanism includes both the optical and electronic parts. Its properties meet the military norm MIL Standard 883B, the circuit having been thoroughly tested to the full extend of the standard's strict demands. This provided a display unit which can be safely used even outside of enclosed spaces. Its applications in military technology and in production facilities are under consideration. Luminance is set automatically in relation to external illumination. It has a four-point display with 17-segment 3.8-mm-high red symbols and with the built-in CMOS circuit it can operate in a temperature range of -55°C to 100°C.

Figure 1. MDL2416 hermetically sealed display unit

As the density of flow of information, cables and transmission channels keeps increasing, communications administration authorities are forced to provide strict enforcement in order to prevent the individual services from increasingly interfering with one another. Siemens offers two transistors that meet the stricter communication regulations. The BGY98 type is designed for large shared systems and for cable amplifiers. The BFR96S type is designed for small sets and for repeater amplifiers along cable lines. Both transistors are suitable for terminals of antenna amplifiers. Their technical properties have been selected so as to prevent interference with the quality of video image despite high density of information. The BGY98 dual transistor consists of two separated, but technologically identical systems in a SIL 9 casing. Such an element makes it possible to devise wide-band series or push-pull amplifiers up to 126 dB V in the 40 to 3,000 megahertz band. Maximum power dissipation is 2 watts per system. High symmetry of the push-pull amplifiers using the above-described transistor contributes to the minimization of interference products. The new BFR98S type is also characterized by improved linearity in comparison to its predecessor BFR96. It, too, is designed primarily for wide-band antenna amplifiers with high demands on suppression of interference products. Maximum power dissipation is 0.7 watt.

Integrated Timer

Prague SDELOVACI TECHNIKA in Czech No 4, 1984 p 143

[Excerpt] Authors of contributions reporting on new foreign products are as vulnerable to doubts as editors of technical periodicals about the degree of detail with which information should be provided, whether brief information would suffice to point out that there is something new, or whether it would be suitable to provide detailed wiring diagrams and examples of applications of the new product. At the time the contribution is published the new product is not available and, thus, the significance of connections is of merely theoretical

interest to the reader; at the time the new product becomes available, its user cannot find much information in the contemporary publications and is forced to look for suitable wiring diagrams in past volumes.

The same applies to the integrated timer 555, which was introduced on the world market approximately a decade ago. After the first contribution was published and after it was corrected and supplemented, there followed additional articles explaining its function and tens of wiring diagrams with an all-purpose timing circuit.

An integrated timing circuit is now produced also in CEMA countries, specifically in the GDR and Romania, so that it should be available in our country as well, especially since it has been incorporated into the upcoming series of parts for electronics and its price has already been determined: BE555 (Romania) Kcs 22.00. Inconsistencies in designation (the heading in [deleted reference shows B555G and later only B555D, [deleted reference] mentions BE555, while [deleted reference] list BE555, reporter's note) should not affect wide application of this well-designed timer in all spheres of electronics. Expanded application of the 555 timer calls not only for its availability, but also for adequate applicational wiring systems whereby thorough knowledge of the circuit's functioning will promote its efficient use with the utilization of its outstanding properties. Familiarization with the timer's function and its utilization in other than timing circuits forms the subject of this article.

State, Development of GDR Microelectronics

Prague SDELOVACI TECHNIKA in Czech No 5, 1984 p 178

[Text] Thanks to timely recognition of the significance of microelectronics, particularly of complex integrated circuits and microcomputers, to the development of electronic processing of information, automation of production processes and other activities, GDR industry has now at its disposal a vast array of modern parts and circuits for the most varied applications. Intensive and systematic efforts toward the promotion and application of microelectronics have been developed particularly since 1977, whereby the center of attention are its applications in control, computer and communication technology, robotics and consumer electronics. The requisite parts and circuits are supplied by the domestic electronic industry or are imported from the USSR and other socialist countries.

An important role is played herein by specification of the production assortment that takes into consideration the needs of the national economy, the potential for type unification and the capacity of production plants. On the basis of this approach it became possible, e.g., between 1978 and 1982, to achieve within the Mikroelektronik Combine a high yearly increase in production; this amounted to 25.5 percent in bipolar integrated circuits, 36 percent in MOS circuits and as much as 73 percent in optoelectronic components. Along with it came increases in imports from other socialist countries. Taking 1980 as a basis, imports were 121 percent in 1981, 152 percent a year later and the

outlook for 1983 was 197 percent. The focal point for imports were parts for high-capacity electronics, semiconductor memories and logic circuits.

Users of microelectronics in the GDR now have at their disposal a wide offering of parts and circuits, ranging from high-performance 8-bit microprocessors (U880) and a single-chip microcomputers (U881 and U882), semiconductor memories with up to 16-kilobit capacity, standard digital and analog circuits, to the most varied special parts for optoelectronics (displays, optical links), sensors with parts bonded by charge, high-performance switching transistors that can be used up to 10 A, and many other parts resulting from the development of the domestic electronics industry. Microelectronics production is to increase annually by 25 percent until 1986 and for the same period it is envisioned to double the number of types of parts and circuits now in production. Among the envisioned new products are, e.g., 8-bit microprocessors with improved dynamic properties, a 16-bit microprocessor, memories with up to 64-kilobit capacity, transmitters and receivers for systems using transmission via fiber lightguides.

Production of microelectronic parts makes use of high-quality basic materials Si, GaAs and GaP from domestic resources and has also at its disposal a wide assortment of silicon plates and monocrystals prepared by Czochralski's drawing method (100 mm diameter) or by zone melting (76 mm diameter). Even the requisite technological complexes were supplied by the domestic industry. For example, since 1981 the Carl Zeiss enterprise in Jena has been turning out an integrated set of production and control systems of a new generation, including the ZBA-20 electron lithograph, ZRM-20 electron scanning microscope, AUR automatic reducing repeater camera, SVG-160 system for control of aligned stencil super-imposition and the Technival 2 stereoscopic microscope (see SDELOVACI TECHNIKA No 1/1983, pp 19-20). The level of integrated circuits production in the GDR will be determined by the mentioned devices until approximately 1985, when new innovations are expected to make their appearance.

Production of instrumentation for chip assembly, sputtering or vapor depositing and microwelding is provided by the Mikroelektronik Combine, while other requisite equipment (e.g., for ion implantation, isolation of diffusions and processing of silicon plates) is imported from the Soviet Union. Various special materials--pure chemicals, gases, conductors, ceramic casings, quartz crystals, etc.--are also supplied by the domestic industry.

In keeping with internationally accepted prognoses, experts in the GDR share the opinion that the application of microelectronics in the most varied areas will see an approximately tenfold increase by the year 2000 in comparison with the present state. The result such a dynamic development will be that annual increases in the production of microelectronic parts and circuits will exceed by far the rate of production increases in other branches of the national economy. The qualitative level of microelectronics will at the same time keep improving in connection with the intended applications. For example, in communications technology it will become necessary to develop and produce devices capable of processing signals of up to 20 GHz and, further, devices facilitating optoelectronic transmission on 0.85, 1.3 and 1.6 um. Computer

technology, tasks related to automation of production, office operations, etc., will call for the introduction of serial production of high-performance 8-, 16- and 32-bit microcomputers, high-capacity RAM, ROM and PROM memories, sensitive sensors (particularly of the CCD type), fast converters and displays with a high degree of resolution. Transition from LSI to VLSI degree of circuit integration will become more conspicuously manifested in the country as early as the late 1980's.

The rate of development and economic utilization of new technological methods and systems for production of microelectronic circuits is much faster compared to innovative processes in other sectors, but the increased costs must of course be covered by increased production capacity. The time during which new technologies become effective (the optium innovation cycle) since 1976 has been 2.5 to 3 years for microelectronic parts and 5 to 6 years for electronic devices, a duration much shorter than that in other industrial sectors (e.g., in mechanical engineering it is more than 10 years).

The key sets of tasks faced by the GDR electronics industry include:

--the utilization of selected new principles in devising instrumentation (e.g., direct exposure by electron beam, x-ray lithography, plasma or reactive etching or engraving);

--a scientific approach to the implementation of potential new systems for the supervision and control of production processes, automation of technological operations, modeling of production processes, utilization of computers in the development of new technologies;

--the preparation of new materials and optimization of their properties with the objective of improving the stability of technological processes and yields;

--more flexible utilization of the production base to promote effective expansion of the assortment of microelectronic parts and circuits;

--the utilization of technological principles and upgrading of those used in the preparation of VLSI circuits and in the production of other microelectronic parts, such as analog and digital circuits, monolithic converters, high-performance parts, integrated sensors, etc.

In order to approach the already-known limits of possibility offered by silicon circuits from the present on, it will be necessary immediately to start preparing technologies which are to be introduced after 1990. Other developmental programs must be oriented toward parts capable of operating at high frequencies, optoelectronic and other high-performance parts. In addition to silicon, considerable use of materials of the A_{III}-B_V type is envisioned. Together with the increasing density of integration there is a need for improving the efficiency of parts to make them commensurate with the increasing demands of users of microelectronics. Expansion of the production assortment by special types developed on the basis of customer demand will be of great importance. By making use of the functional flexibility offered by semicustom

circuit design, particularly logic fields, it will become possible to reduce production costs even in the case of limited series production. Nevertheless, their effective application on an even larger scale will call for even closer cooperation between parts producers and users.

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New CSSR Personal Computer

Prague SDELOVACI TECHNIKA in Slovak No 6, 1984 pp 211-213

[Article by Eng Roman Kiss: "PMD-85 Personal Computer"]

[Excerpts] The objective of this contribution is to familiarize readers interested in small computer technology with the configuration and software possibilities of the PMD-85 personal computer developed by the Tesla concern enterprise in Piestany. Its design opted for the strategy of minimum circuitry oriented toward structural modules of the 8080 microprocessor family with maximum software support. Its given architecture makes it possible to display (1 bit=1 point) the contents of a specified memory page on a display unit which can be a TV monitor or a standard television set. The role of software, specifically with the aid of the higher programming language BASIC, is to fill a memory image page which is point-oriented and organized in 288 x 256 points (width x height).

Technical Description of the Computer

The PMD-85 computer's architecture is indicated in Figure 1. It shows that the computer consists of several independent modules, specifically:

--a microcomputer module wiht an image processor which forms the computer's basis enabling it to operate as a conventional microcomputer with alphanumeric readout (by using an external display unit, e.g., Consul 7202) or with an output to a standard television reveiver with point display capability. The module contains 61 integrated circuits and for operation requires merely a feed voltage of +12 V, -5V, +5 V, a display unit (television receiver) and a keyboard. In essence, the module contains two basic blocks. The first is a conventional microcomputer with MHB8080A microprocessor, its supporting circuits MH8228 and MH8224 and a ROM memory of 4 kilobytes capacity in which is located the operating system. The second block is a discrete image processor with circuit of a low degree of integration. Both blocks are coupled by means of a RWM memory consisting of MHB4116 dynamic memories with 48-kilobyte capacity. They share in common one memory page, called the image page, because it stores the values of all imaging points in the 288 x 256 point raster.

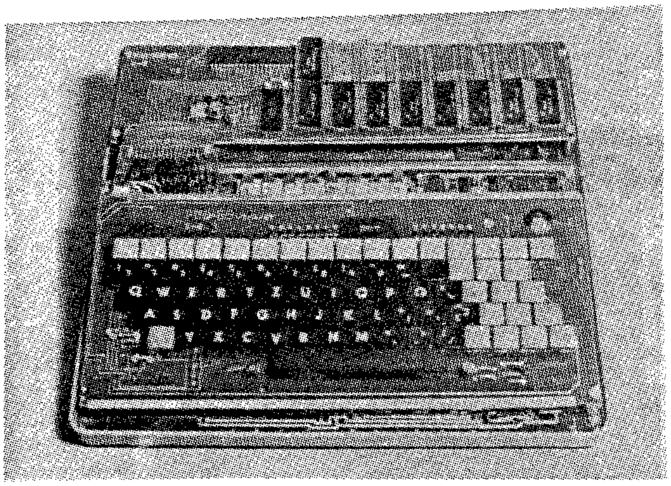

Figure 5. View of the computer's design

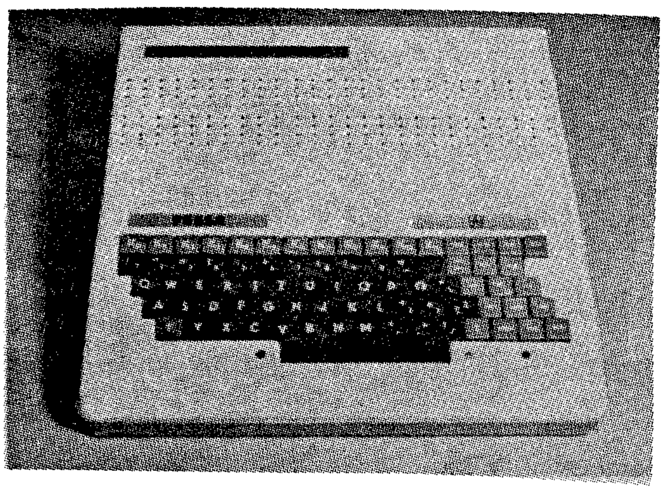

Figure 6. Overall appearance of the PMD-85 computer

ADP in USSR

Prague SDELOVACI TECHNIKA in Czech No 6, 1984 p 231

[Text] The Soviet Union has launched construction of a network of centers for automated processing of scientific and technical information. Domestic and foreign publications from the sphere of science and technology are currently processed by approximately 20,000 collaborators of the All-Union Institute for Scientific and Technical Information (VINITI) of the USSR Academy of Sciences. The systematic offering of information about new developments is made possible by analysis of periodicals and technical literature from the most varied countries of the world. For example, VINITI received in 1982 over 40,000 periodicals, compendia and monographs as well as other publications from 130 countries written in 66 languages.

The assessment of the analyzed sources is published in four types of publications. The first are the so-called signal bulletins, which offer information about all the materials that appeared worldwide as of a certain data. Intended for use by the technical public, "Express Information" reports on foreign publications. Outline monographs entitled "Findings from Science and Technology" are the result of analyses of key problems for the past 2 to 3 years. VINITI's key informational output are report-type publications with annotations to articles published in technical periodicals of various countries. The number of assessed sources exceeds 23 million. Reports on foreign materials appear approximately 3 months after their publication, those on Soviet publications appear in 4 to 6 weeks.

VINITI started automating the issuance of all publications in 1983 by storing the analyses in computer memory. It is envisioned that it will soon become possible to transmit the desired information through data channels to users of their information service, the number of which amounted in 1982 to approximately 565,000. Of the latter, 88,000 subscribers are abroad, in 76 countries, among them the United States, Great Britain, Japan, the FRG and France.

The Soviet Union is currently also devising a special system for the storage and dissemination of manuscripts. Operations are already under way in 95 centers which keep an archive of manuscripts of all new technical studies so as to make them accessible to a wide circle of interested parties. Some 7,500 manuscripts will be deposited annually and attention will be called to them in one of VINITI's publications.

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SCIENCE POLICY, MICROELECTRONICS DEVELOPMENT ASSESSED

Science Policy Changes

Warsaw TRYBUNA LUDU in Polish 5 Jul 84 p 3

[Article by Tomasz Miecik: "Most Important for the Nation: Research Under Special Supervision"]

[Text] The weak point of our science policy is its inability to give simple answers: yes or no. Yes--with all kinds of priorities--should be said to research that is most important and most urgent from the point of view of the nation's needs. No should be said to studies that can wait or are generally not necessary in a nation of Poland's size.

More than a decade ago, when research and development accounted for a relatively large proportion of Poland's gross national product (over 2 percent), it was acknowledged that these funds should be properly managed. Changes were made when a transition occurred from the organizational-unit [plant and equipment] to product [goods and services] principles of research financing. It was a major change in science and technology, where, for a long time, it was customary that once an institute existed it would receive money no matter what the quality of its research.

In turn, in order to ensure that this new financing of science was organized into complete cycles and in this way made more efficient, a hierarchical system of centrally managed scientific research was introduced. It consisted of government programs (their current number is eight), nodal problems (72), interministerial problems of basic research (74) and ministerial problems (220).

Implementing this science policy innovation over some time provided a perfect illustration of how an appropriate, progressive and modern concept, because of insufficient follow-up, becomes subject to pressures and works opposite to the original concept, loses its goals and fails.

The government program eventually encompassed virtually the entire sphere of scientific research and development. The principles of product financing

were in practice replaced by a reversal to organization-unit financing. The proliferation of privileged projects disrupted the principle of concentration of funds and resources, increased the lack of coherence or produced loose connections of individual programs with the social and economic goals of national importance, resulting in a lack of selectivity in scientific research.

The changes in science policy initiated in the 1970's were not an original concept. Almost all nations with an advanced scientific and technological potential and the same economic system conduct the most important research projects with government financing similar to our governmental and nodal programs.

However, everywhere--both in the West and East--it is difficult to become part of such projects. Only the best institutes and groups, which can guarantee effective research closely linked to the goals of the program, can expect to be selected. On the other hand, in Poland the privileges were so numerous and programs spread out so thinly and implemented on such a broad front that almost everyone who wanted--and who wouldn't want manna from heaven?--could easily "tap" with their research into these funds. With this came a guarantee of comfortable living because evaluation of program implementation and vertification did not occur frequently, and when it did was quite liberal.

These are the reasons why we have not obtained the expected effects from studies which, at least by appearance, seem to be extremely important. The number of innovations, even with limited funds allocated for scientific and technological research (in Czechoslovakia and the Soviet Union the share of gross national income earmarked for this purpose is twice or three times as large) could have been much more numerous.

These, however, are not the sole reasons.

An advanced or final-stage in many research projects when their effects can be put to use coincided with the mounting crisis and economic difficulties which involved financial limitations. Many of the research results thus remained in limbo and were never introduced into the economic practices because of a lack of implementation funds. This is true of research projects in a range of centrally managed programs, including the most important area, the so-called government programs. Recent analysis of the progress of government research programs completed by the Department of Scientific Research of the Ministry of Higher Education, Science and Technology confirms this.

For instance, there are delays in implementing the program of comprehensive processing of coal. The initial program gave an optimistic estimate of the research and investment potential in coal processing.

Limited funds caused discontinuance of several projects in the program entitled "Optimal Utilization of Resource and Development of Manufactured Products Made of Copper and Copper Alloys." Hard currency shortages and investment limitations caused delays in the government program for "Industrial Introduction of Electronics."

The plan for realization of the program "Optimization of Production and Protein Consumption" has largely been modified mainly, to cancel the elements based on technologies using imported raw materials such as soy beans and corn. Here, too, the completion of the program will depend on the possibility of implementing the results of scientific research and their promulgation. For a similar reason and shortage of equipment and research facilities, there have been delays in implementing the government program on "Comprehensive Development of Housing Construction."

Fortunately, it is not from all fronts of government research that such sad tidings are received. For instance, in the program "The Fight Against Neoplasmic Disease," most of the goals projected from 1976 to 1983 have been achieved. In particular, major accomplishments have been attained in epidemiology, medical physics, radiation therapy and nuclear medicine, despite the changed economic situation and conditions for international scientific and technological cooperation. Research and development items of that program have been implemented to 96.8 percent in 1983, which was not an easy year, as compared, for example, with just 38.2 percent of the target in new housing.

This analysis was necessary in view of the upcoming (at the end of 1985) financial and substantial evaluation and selection of government programs, and intensified planning effort in areas covered by the existing government programs. New principles should be based primarily on the past experiences, on evaluations of the progress achieved thus far, as well as such obvious factors as the changing economic environment in the country and new conditions of scientific and technological cooperation on the international scale.

This is, however, just one element of the general changes in the system of management of science and technology. From what we know as of now emerges a concept of direct government financing of long-term research and development programs pursuing strategic goals, which must be selected with care so as to concentrate available resources on their speedy achievement. A consolidated system of government-sponsored research will thus supersede the hierarchical structure of government, nodal, ministerial, etc. programs.

On the other hand, shorter-term tasks, such as those set by annual or five-year central plans and associated with the development of new products, processes and technologies (which is usually beyond the powers of an individual enterprise), will be covered by government contracts.

This sounds like a workable concept. Yet, is it not reasonable that government research programs of the long-term type should support the existing Polish specialties in science and engineering and create new ones, to reflect the changes in the economy and the international division of labor? Government contracts in science and technology will cover efforts from research and development through implementation, operating with the help of such tools and incentives as state subsidies, credit lines and privileges, eventual price subsidies for new products, assistance with materials supplies and hard

currency quotas for imports, relief with payments into PFAZ fund, and other forms of support.

On a sobering note, this is merely a concept. How will it be brought into effect? Will the efficacy of research, the utilization of funds committed by society be adequate from the early stages of research work organization? We will be watching developments closely in order to be able to answer these important questions.

Microelectronics Development Lag

Warsaw TRYBUNA LUDU in Polish 16 Jul 84 p 4

[Interview with the learned secretary of the Institute of Electronic Technology Jaroslaw Swiderski and deputy director for technology and production of Semiconductor Research and Production Center Stanislaw Goledzinowski by Adam Hollanek: "Science and Practice: A Thousand Unanswered Questions"; date and place not specified]

[Text] Is it possible to get by in the modern world without microelectronics, and what is Poland's situation in this area? We asked these questions in an interview with Professor Dr Jaroslaw Swiderski, learned secretary of the Institute of Electronic Technology, and engineer Stanislaw Goledzinowski, deputy director for technology and production of Semiconductor Research and Production Center.

[Question] Why is the development of microelectronics so important and what is Poland's orientation in this area?

[Answer] As regards the actual needs, Poland experiences a shortage of integrated circuits of the large scale of integration (including microprocessors), which is so acute that we would have to increase their output five times over if we want to meet this demand! That there is an awareness that these components are necessary, especially among those working in industry, is evidenced, for instance, by about a thousand letters we have received from miners, metallurgists, shipbuilders, factory managers and from many other branches of services and industry, including agriculture, medicine and education. People are asking why these products are in short supply and when they will be available.

Microprocessors, which are the latest generation of integrated circuits, increase productivity drastically (through automation and electronic management and control), improve the functional reliability, simplify manufacturing processes and products and save energy. One can hardly list all the benefits, but just a few characteristic examples will do. By introducing a microprocessor into the standard sewing machine, it was possible to eliminate from its design 350 moving components. An electronic watch takes about five assembly operations to produce; compare this with about a thou-

sand operations in making a conventional, mechanical watch. An electronic programming device in a washing machine breaks down a million times less often that a mechanical system. Ships with computerized navigation, during the past four years, had no single collision with other floating objects. It seems that the benefits of microelectronics are better perceived by scientists and engineers in industry than by administrators responsible for economic advance.

[Question] How should we understand this? Isn't it known that, in CEMA nations, numerous Polish electronic products enjoy popularity and success, as confirmed, in particular, by contracts with Hungary for supply of Polish kinescopes concluded at the last Poznan fair and by similar agreements?

[Answer] We are not saying that nothing is accomplished by our electronics. Just on the contrary, in a critical situation, we are trying to obtain results that are an improvement on previous periods. For instance, at CEMI, quality and quantity of production peaked in 1980. In 1984, we are trying to produce 25 percent more integrated circuits than at that high point!!! The output has grown despite reduced work force, which is an illustration of improved productivity, proportional to the "electronic input." Employment has declined by more than thousand persons. New assembly lines have been brought into operation--at Ostroda and Monki near Byalystok. The supply of semiconductor components to the market has been increased by more than a million units, produced largely to meet domestic demand and also for export.

Scientific research has made it possible to greatly reduce the import of foreign technology for factory equipment. Based on domestic developments, every year more than 30 types of new semiconductor components are brought into production. However, our efforts to maintain and raise the technological and production level failed to surmount the unfavorable situation. Despite the export of certain types of semiconductor components to socialist countries, we are slipping into the role of a poor relative in the socialist camp, becoming a partner that matters less and less. We will not cite data on subsidies and outlays on development and research in microelectronics in other countries, such as Hungary, Bulgaria, Rumania and GDR, but the numbers are substantial.

[Question] Apparently, capitalist nations have long pursued this policy, too.

[Answer] That is correct. Large sums are invested in microelectronics, especially in circuits of a high degree of integration, particularly microprocessors. A microprocessor with memory systems and peripherals constituting a microcomputer and used in everyday life (and, of course, economy!) is the size of a thumbnail and takes just 0.75 V energy supply. Microelectronics is entering more and more areas, from pocket calculators and watches, to teleprinters and telecopiers, to electronic communications systems, to robots, automatic machine tools, medical equipment, diagnostic equipment, communications control, photo cameras and projectors, electronic games, automatic regulation of heating and lighting systems, home computers, automation of railroads and space technology.

What is being done in Poland to meet our demands and create capacities for rational export, however, is no more than the proverbial drop in a bucket.

{Question} What evidence supports this characterization?

{Answer} On top of the thousands of letters we receive every year from factories and various public and economic spheres concerning microelectronics we have mentioned at the beginning, convincing evidence is the fact of continuing labor shortages in industry and various other spheres of economy. Functions that could be performed by a few individuals currently take dozens of workers. At many factories, most work in equipment and transportation services is done by old, labor-intensive methods. Manual labor still accounts for a large share of operations, exceeding the share of mechanized and automated processes. This is a waste of manpower.

Another confirming fact is the estimates made by experts (including the late Professor Kopicki), who have calculated that, if in the coming few years we do not increase our power production by building more conventional or nuclear power plants, we will be exposed to an energy crisis whose symptoms can be seen even today.

Our energy experts are working well, but the facts of electricity shortages with our limited potential result in underutilization of capacities at new factories, even with increased employment. Simply, undersaturation of our economy with microelectronic devices is being felt already and will become even more painful in the future!

{Question} How far does Poland lag behind in the top-of-the-line microelectronic components, microprocessors and their basic elements? Have we at all attained the frontier of modern hardware miniaturization and are we not compelled at this point simply to import everything?

{Answer} We manufacture certain types of microprocessor systems. As regards quality, we have a fairly good medium level. Yet, there is a shortage of technology for further developing this production. No nation currently produces everything it needs for microelectronics, but Poland's lag in manufacturing of, for instance, microprocessors already, compared to advanced nations, is measured by seven to eight years. Even if the productive capacity could be maintained and increased until 1990, this gap could double. Unfortunately, we cannot count on supplementary imports of integrated circuits, because high development and introduction costs of new microelectronic technology resulted in a situation where offered through world trade are complete systems, furnished with microchips, rather than the chips themselves. Even that marketing technique sometimes hardly breaks even!

This means developing final, complete equipment for computerization in various fields. We should develop as fast as possible our own production of microchips, partly to trade them for subassemblies produced by other nations that we lack or that involve highly sophisticated manufacturing.

[Question] What are the chances of this development happening?

[Answer] One thing is certain. If today, according to the commonly used criterion, Poland is still at the stage of 8-bit microprocessor systems, we will be able to overcome delays in the underequipment of the economy by microelectronics before 1990 only by rising up to where mass production of the next generations of microprocessor systems will become possible. In that case, we will be not 15 years behind, but will cut the lag and be just 10 or maybe seven years behind, depending on the investment, in zlotys and hard currency. Obviously, in our conditions, such decisions are difficult, but no less important. In addition, this involves training (which is also expensive) a sufficient cadre of skilled specialists. Without this human factor, one could not even dream about introduction of microelectronics. But the possibility is there.

It should be added that we are happy about the attitude of younger professionals, about the fact that young engineers and technicians in various industries are excited about the applications of microelectronics and view electronics as a great asset, offering a real prospect for the future. This is the bright spot in the generally gloomy picture of Poland's microelectronics today.

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STEEL INDUSTRY COMPUTER SYSTEMS ASSESSED

Warsaw PROBLEMY PROJEKTOWE in Polish No 2, Feb 84 pp 45-53

[Article by Jerzy Kardaszewicz and Tadeusz Michalski, Biprohut Enterprises, Gliwice: "A Survey of Computer Systems of Process Control in Polish Steel Industry"]

[Text] The article describes the conditions and methods of implementation of computer control systems of engineering processes between 1971 and 1982 and characterizes the functional and hardware aspects of these systems.

Introduction

This survey is concerned with computerized systems of control of industrial processes operating in real time and coupled with objects being controlled through measuring sensors and elements that have direct or indirect effects on the operating components, such as drive control systems, flow intensity regulators, etc. We do not consider computer systems that perform data processing for management of production or processors and computers built into measurement instruments and analyzers (such as spectrometers) and programmed controllers.

Computerizing the systems of industrial process controls in Polish metallurgy began on a large scale in 1970. Two factors were taken into consideration:

--the launching of the national research and development program under the aegis of the nodal problem, "Development of Systems of Comprehensive Automation," coordinated by Comprehensive Automation Enterprises of the Polish Academy of Sciences in Gliwice (ZSAK-PAN) and

--implementation of an intensive program of metal industry development and the possibilities for investment purchases in the hard currency sphere.

Earlier, sporadic attempts at installing computers to control operational processes at the Lenin Steel Works in Warsaw and Labeda were generally unsuccessful, because hardware was unreliable and there was a lack of interest on the part of the participants.

Between 1971 and 1980, altogether 25 industrial process control computer systems were developed, including 21 that were introduced into industrial exploitation. One of the systems was never implemented. After an initial period, one of the systems was abandoned, and in two other cases the implementation was impossible because of a discontinuance of investment funds. One system is still in the development stage.

The efforts toward computerization of industrial processes between 1971 and 1982 are subdivided into three groups:

(a) pilot projects aimed at collecting technological and organizational evidence and personnel training;

(b) automation of the existing operational objects previously controlled without computers; and

(c) automation of new objects which are built and brought into operation together with a computerized system.

A pilot project implemented by Biprohut Enterprises between 1971 and 1973 within the framework of the nodal problem coordinated by the ZSAK-PAN was a relatively simple system for control of reversing rolling mill at Florian Metal Plant. The system was equipped with a Hewlett-Packard HP2116C computer with standard auxiliary devices. The project and system algorithm with specialized auxiliary devices and communication units linking the system with the controlled object were built by Biprohut and Central Enterprises of Metallurgy Automation. The control system and application software were created by the Institute of Steel Metallurgy in cooperation with Biprohut. The following conclusions were drawn on the basis of that experience:

(1) The control of a technological process in industry requires highly reliable hardware and operative system. In the 1970's, such hardware was not available from Polish or CEMA sources.

(2) Development of software for several systems within relatively short time (about one or two years) required by the discipline of investment funding calls for concentrating a large number of specialists or having prototype software modules adapted for the specific computer hardware that could be combined into various configurations, depending on specific needs. In the 1970's, no adequately trained personnel for that purpose were available.

(3) A future user must take an active part in designing and developing the software, testing and implementing a control system.

(4) Before mounting a system at the user enterprise, comprehensive tests of the hardware and software should be conducted in a simulation framework.

Based on these conclusions, the following practical decisions were made concerning the major systems to be introduced between 1975 and 1980:

(1) import of high-quality hardware from the hard currency markets;

(2) joint development of programs by hardware suppliers and users or special project bureaus;

(3) large-scale personnel training at user enterprises and their active participation in system introduction; and

(4) special stringent contractual requirements as regards selection, testing and functional and reliability guarantees on the part of the supplier.

A positive factor in automating the existing objects was the good knowledge of the processes by the users and the possibility of coordinating with them the requirements and conditions of computer system operation. Difficulties stemmed mainly from the routines and traditional habits of the personnel and the need for adjusting the objects to computer control (installing sensors and drives).

This did not interfere with favorable, although sometimes difficult, efforts of introducing and bringing into operation the control systems at the existing technological objects at the Lenin, Bierut and Batory Metal Plants.

Other difficulties were faced when developing new plants, which were to be controlled by computerized systems from the very beginning:

(1) While designing and defining the functions of the system, the future user was as yet unfamiliar with the technological process sufficiently to take an active part in the discussion, and the user personnel were quite often not yet assigned.

(2) During the development and introduction of the object, the investor and the user were trying to obtain rapid production effects, sometimes at the expense of complete installation and optimal quality of products. As a result, the introduction of computer systems was delayed to a later date after the beginning of the plant operation and often after the expiration of warranties.

(3) During the introduction phase, the users exhibited total lack of interest in the system or advanced additional requirements which could not be met because they were not planned for in the original design.

For the above reasons, some of the projects in this group were not successful. A large number of these difficulties could have been avoided if the development of the computer systems had been planned for a period following the initial introduction of the object into operation.

For financial reasons, however, that solution was not possible, because regulations required that the entire investment be realized and calculated within the prescribed time frame. Finding funds, especially hard currency, for computer systems, if viewed as a separate investment assignment, was impossible.

Table 1 surveys the computerized control systems developed for various metal plants, and Table 2 gives data on control computers received by the steel industry between 1972 and 1982.

Table 1. Computer Systems for Process Control Developed Between 1971 and 1980

	Department	No. of systems Developed	Operational	Remarks
1.	Large furnaces	4	4	
2.	Converter steel furnace	2	2	
3.	Electric steel furnace	3	3	
4.	Steel rolling mills	16	12	Investment suspended - 2 Installation stopped - 1 Operation discontinued-1
	Total	25	21	

Table 2. Computer Systems for Process Control Supplied Between 1972 and 1982

	Producer	Type	No. of processors Deliv-ered	Opera-tional	Remarks
1.	Mera-ZSM	Mera-306	1	1	
		Mera 360.02	1	1	
		Mera-360	1	1	
2.	ZEG-Tychy	SMC 3	1	-	Operation discontinued
3.	Digital Equipment Corporation, USA	PDP-8E	1	1	
		PDP-11/05	6	5	
		PDP-11/35	9	7	1 under development
		PDP-11/34	3	3	
4.	Honeywell, USA	HS-PAC 4010	2	2	
		TDC 4500	3	-	Investment discontinued
5.	Hewlett-Packard, USA	HP-2116 C	1	1	Objective changed
6.	Pignone Sud, Italy	PS-PAC 3010/2	1	1	
7.	Siemens, FRG	Siemens 310	2	2	
		Siemens R10	1	-	Investment discontinued
8.	Toshiba, Japan	Tosbac 40B	2	2	
9.	Mitsubishi Electric Corporation, Japan	Melcom 350-7	2	-	Under development
10.	Skoda, CSSR	ADT 4100	2	1	1 utilized for spare parts
11.	Taylor, UK	Taylor 1010/70	2	-	Investment discontinued

Characteristics of Systems Operational in 1983

Large Metal Furnaces
Lenin Metal Plant Large Furnaces No 1-5

System Adjusting the Load of Coke by Humidity Function

The system serves to calculate the load of coke into five large furnaces as a function of a given dry coke or the results of its moisture content measurement.

The basic functions are:

--receiving data on a given load weight;

--joint operation with neutron moisture content meters;

--calculation of corrected loads;

--control of load measurement;

--printout of reports.

Equipment:

--Mera 360.02 computer with 16 kB memory;

--standard auxiliary devices: tape reader, alphanumeric printer;

--inputs from 10 moisture content gauges;

--inputs from 10 execution mechanisms.

The design software and implementation by Mera ZSM Enterprises and the Lenin Metal Plant.

The system has been operational since the first quarter of 1975 for one furnace and since the second quarter of 1976 for all furnaces.

Lenin Metal Works: Large Furnace No 5

Technological Process Control System

The function of the system is to assist the furnace master in measuring the charge mix.

Based on data introduced from remote printer, which includes among other information the results of chemical analysis of the components and direct data on the process from 28 analog inputs, the system calculates and prints out recommendations. The algorithm is based on a mathematical model developed by the Steel Metallurgy Institute of the Academy of Mining and Metallurgy.

Equipment:

--Mera 306 computer with 16 kB memory;

--disc memory 2.5 MB;

--industrial channel Inteldigit PI;

--standard peripheral units: tape reader and punch; alphanumeric printer.

Design, software and implementation by Academy of Mining and Metallurgy and the Lenin Metal Works.

The system has been operational since the fourth quarter of 1979.

Katowice Metal Works: The Department of Large Furnaces

Systems of Control of Large Furnaces No 1 and No 2

The department has two identical large furnaces with a capacity of 3200 m^3 and belt loader. For each large furnace a separate computer system has been designed. The system functions are subdivided into two interlinked computer units, constituting subsystems A and B.

The basic functions of subsystem A are:

--receiving data on loading program;

--controlling the filling of scale hoppers;

--continual correction of the weight;

--correction of the coke load as a function of moisture content;

--initiation of the loading cycle;

--control of emptying of scale hoppers;

--tracking the transport of the load on the conveyor;

--setting of the entry units;

--control of the sequence of operation of entry devices;

--control of the operation of equipment;

--printing reports and display of messages.

Basic functions of subsystem B:

--receiving data from 16 sensors controlling the process;

--calculating the composition of the mix;

--process control based on mathematical model;

--report printout.

Equipment of each of the systems:

--two PDP 11/05 computers with 64 kB and 32 kB memories;

--disc memory 2 x 2.4 MB and magnetic cassette memory;

--standard peripheral units: tape readers and remote printer;

--units for communication with operators: monitor with a keyboard, message printers, matrix tables, operator keyboard and mnemonic tables;

--industrial channels (368 static numeric inputs and 256 outputs, 70 variable inputs and 50 analog inputs).

The design, software and implementation by ASEA (Sweden), Biprohut and Katowice Metal Works.

Subsystem A has been in operation since 1977 (furnace no 1) and 1978 (furnace no 2).

Research is currently under way on two furnaces with the purpose of successive introduction of control algorithms based on mathematical models of industrial processes. Inadequate quality of measurement processors has caused major difficulties and delays in implementation of subsystem B.

Steel Mills

Lenin Metal Works - Converter Steel Mill

System for Control of Oxygen Converter Process

The system controls the process of steel melting and is based on a static mathematical model.

The basic functions are:

--calculating the components of the charge and the blasting method;

--sending messages to the operator keyboard;

--process control;

--immediate control of dosage of additives and oxygen flow;

--central registration and processing of data from 70 measurement sensors;

--printout of the melting chart and other reports;

--data transmission to the computing center of the enterprise.

Equipment:

--PS-PAC 3010/2 computer with a 64 kB RAM memory (Pignone Sud/General Electric);

--disc memory 2 x 2.4 MB;

--1350 digital inputs;

--840 digital outputs.

The design, software and implementation by Lenin Metal Works, with the support of Pignone Sud (Italy).

The system has been in operation since the fourth quarter of 1977 for the first converter and since the fourth quarter of 1980 for three converters.

The scope of functions is being expanded.

Nowotko Metal Works - Electrical Steel Furnace

System for Steel Melting Control Process

The system operation embraces three electric arc furnaces and scrap warehouse.

The basic functions are:

--calculating the weight of charge materials;

--melting cycle control;

--energy demand control;

--calculation of additives and alloys;

--spectrographic data processing;

--warehouse inventory;

--report production.

Equipment:

--PDP 11/35 computer with 160 kB RAM memory;

--disc memory 2 x 2.4 MB;

--standard peripheral equipment: tape reader and punch, teletype and printer;

--equipment for communications with operators: teletypes and operator consoles;

--industrial channel (629 static digital inputs and 261 outputs, interrupt inputs, 8 variable inputs, 50 analog inputs).

The design, software and implementation by CERCI (France) and Nowotko Metal Works.

The system has been operational on a limited scale since 1981.

Zawiercie Metal Works - Electric Steel Furnace

System for Control of Steel Melting Process

The system operates on four electric arc furnaces.

The basic functions are:

--calculation of the load of charge materials;

--melting phase control;

--tank temperature calculation;

--oxidation, deoxidation and calculation of alloy additive load;

--control of the peak capacity of the furnace;

--spectrographic data processing;

--report production.

Equipment:

--PDP-11/35 computer with 64 kB RAM memory;

--disc memory 2.4 MB;

--standard peripheral units, tape reader and punch teletype;

--equipment for communication with operators: teletype operator consoles;

--industrial channel (static digital inputs and outputs, interrupt inputs, variable inputs, analog inputs).

Design and software: CERCE (France) and Zawiercie Metal Works.

The system was launched on a limited scale in 1978. In view of technological changes (use of iron ore instead of oxygen), adjustment of the program and mathematical models was necessary.

Since 1980, modified technologic and energy functions were introduced (Institute of Ferrous Metallurgy jointly with Zawiercie Metal Works).

Katowice Metal Works - Converter Steel Mill Department

System for Control of Oxygen Converter Process

The system operation encompasses all phases of the process. The basic functions in the individual phases are the following:

--initial preparation of the melt;

--receiving data on the modification plan;

--receiving and updating other specific data.

Preparation of the charge:

--calculating the weight of charge materials (scrap metal, ore, additives, oxygen).

Melting:

--control of the melt based on static mathematical model: control of intensity of oxygen flow; control of dosage of additives to converter; automatic stopping of blasting.

Melt correction:

--control of additional blasting (if the melt fails to meet the required parameters after the first blasting).

Discharge into the tank:

--receiving steel analysis data from the laboratory;

--calculating the additives and generating appropriate instructions.

Filling the molds:

--receiving the data on the melt from the testing station.

Status after melting:

--updating the static mathematical model;

--developing and printing the report;

--printing the modification report.

Equipment:

--PDP 11/35 computer with 192 kB RAM memory;

--disc memory 4 x 512 kB and 1 x 2.4 MB and magnetic cassette memory;

--peripheral equipment: tape reader and punch, line printer, teleprinter.

--equipment for communication with operator: CRT monitors and digital screens with keyboards; message printer; standard industrial controls;

--industrial channel (747 static digitals inputs and 329 outputs; 163 dynamic digital inputs and 118 outputs; 26 analog inputs and 4 outputs).

Design, software and implementation by Voest Alpine (Austria), Kent (UK), Biprohut and Katowice Metal Works.

The system has been operational on a limited scale since 1980.

Baildon Metal Works - Electric Steel Furnace

System for Control of Electric Steel Furnace

The system serves as an aid to operators for control of technological processes in the furnace for production of special grades of steel.

The basic functions are:

--documenting the condition of charge components;

--selection of charge mix;

--assistance to operator in controlling the electric arc furnace;

--assistance to operator in vacuum steel degassing;

--assistance to operator in control of electric melting process.

Equipment:

--PDP 11/34 computer with 96 kB RAM memory;

--disc memory 4 MB;

--magnetic tape memory;

--standard peripheral equipment (card reader, alphanumeric printer, screen monitor);

--12 remote printers.

Design and software by CERCI (France). Implementation by CERCI and Baildon Metal Works.

System has been in operation since the second quarter of 1979.

Rolling Mills

Lenin Metal Works - Continuous Billet Rolling Mill

System for Control of Optimal Billet Cutting

The system serves for the control of the cutting knife to optimize the production of steel strips and minimize waste.

The basic functions are:

--calculating the optimal strip length based on a measurement of initial length and elongation factor;

--calculating the optimal segment length;

--control of moving knife;

--printing of reports.

Equipment:

--Mera 360 (Momik 8B/1000) computer with 16 kB RAM memory;

--standard peripheral equipment, including tape reader and alphanumeric printer;

--input from 16 sensors;

--control of two mechanisms.

Design, software and implementation by Lenin Metal Works.

The system in its current form has been operational since the fourth quarter of 1978.

Lenin Metal Works - Cold Sheet Rolling Mill

System for Control of Four-Frame Rolling Mill

The system serves for comprehensive control of four-frame duo rolling mill, which is the basic production aggregate of the department.

The basic functions are:

--calculating and tabulating "off-line" rolling programs for various nomenclatures based on a mathematical model of the process;

--setting the rolling mill mechanisms according to charts stored in the system memory;

--controlling the mill mechanisms during all phases of the process, including:

--feeding and preparation of the billet;

--cutting;

--acceleration;

--rolling with a certain speed;

--release at junctures;

--stopping;

--unloading the billet;

--regulation of sheet thickness;

--classification of thickness variations;

--printing reports.

Equipment:

--TOSBAC 408 computer with 64 kB RAM memory;

--drum memory 256 kB;

--standard peripheral equipment: industrial data channel with 896 digital inputs and 384 digital ouputs.

The system receives signals from 56 sensors and serves 22 executive mechanisms.

The design, software and implementation by Toshiba (Japan) and the Lenin Metal Works.

The system has been in operation since the first quarter of 1975.

Lenin Metal Works - Cold Sheet Rolling Mill

System for the Control of 20-Cylinder Sedzimir Rolling Mill

The system makes part of rolling mill equipment and serves for automatic initiation and stopping and also for control of plate metal thickness.

Equipment:

--PDP 8E computer with 4 kB RAM memory.

Design, software and implementation by Waterbury-Farrell (USA), the firm that supplied the rolling mill.

The system has been operation with the mill since the second quarter of 1977.

Lenin Metal Works - Cold Sheet Rolling Mill

System for Control of Continuous Etching Process

The system serves for a comprehensive control of the ethcing process.

The basic functions are:

--computing the optimal process conditions;

--controlling the sheet movement speed;

--controlling the chemical composition in the tank;

--controlling the division of the strip into billets;

--classification of metal in billets;

--printing of reports.

Equipment:

--PDP 11/34 computer with 192 kB RAM memory;

--disc memory 2 x 2.5 MB;

--standard peripheral equipment.

The system receives signals from 18 sensors and serves 16 mechanisms.

The design, software and implementation by Brown Boveri Co. (Switzerland) and Lenin Metal Works.

The system has been operational since the third quarter of 1980.

Lenin Metal Works - Cold Sheet Rolling Mill

System for the Control of Ingot Heating

The system is an auxiliary device for the operator and also performs direct control of bell furnaces in ingot heating department.

The principal functions are:

--ingot warehousing inventory;

--control of ingot loading into furnace;

--computing the heating program;

--controlling the temperature according to program;

--report printing.

Equipment:

--TOSBAC 40 B computer with 64 kB RAM memory;

--drum memory 256 kB;

--standard peripheral equipment: tape reader and punch and alphanumeric printer;

--industrial data channel serving 896 digital inputs and 1354 outputs.

The system receives signals from 256 sensors and serves 92 execution mechanisms.

The design, software and implementation by Toshiba (Japan) and Lenin Metal Works.

The system has been in operation since the second quarter of 1975.

Bierut Metal Works - Thick Sheet Rolling Mill

System for Control of Rolling Process

The operation of the system encompasses the furnaces and rolling mills.

The principal functions are:

--receiving data on ingots and raw sheets that can be made from them;

--tracking strips in the area of system operation;

--predictive-adaptive calculation of the optimal rolling program to ensure required sheet parameters and minimum scrap, given the design and process limitations;

--adjusting the calculated program based on measurement data in previous runs;

--strip temperature control at final cycles;

--direct control of main drives of frames, setting of cylinders, manipulators and flows in the rolling mill area;

--report printing.

Equipment:

--Honeywell HS-PAC 4010 computer with 24 kiloword RAM memory;

--drum memory of 120 words;

--standard peripheral equipment: tape reader and punch, card reader and teleprinter;

--industrial data channel with digital and analog inputs and outputs.

The system receives signals from 25 sensors and controls 15 drives.

The design, software and implementation by General Electric Co. (USA), Biprohut and Bierut Metal Works.

The system has been operational since 1976. Currently, it has been expanded, including increasing the working memory, replacing the drum memory with static external memory, installation of plate thickness and breadth measurements instruments.

Bierut Metal Works - Thick Sheet Rolling Mill

System for Control of Sheet Cutting Line No 2

The system provides sequential control of mechanisms of sheet cutting line.

The basic functions are:

--sheet monitoring;

--setting devices based on required strip parameters and cutting program;

--control of positional mechanisms;

--sequence control;

--failure signalization.

Equipment:

--two Siemens 310 computers with 64 kB RAM memory;

--standard peripheral equipment (including three screen monitors).

The industrial data channel serves inputs from 140 sensors and outputs to about 50 controlled mechanisms.

The design and software by Siemens (FRG). Implementation by Siemens and Bierut Metal Works. The system has been operational since the fourth quarter of 1980.

Nowotko Metal Works - Small Rolling Mill Department

Rolling Mill Management and Control System

The system activity embraces the entire rolling mill operation from the heating furnace to warehousing of products.

The system functions are subdivided between three interconnected computer units, constituting the subsystems TR, MP and FC.

The basic functions of the TR subsystem are:

--receiving data on modification plan;

--strip monitoring;

--registration of operation and idle time of the rolling mill;

--control of rolling programs;

--determining the rolling speed;

--control of strip cutting;

--control of material transport in the area of the cooling installation;

--control of finishing operation;

--control of cylinder wear and tear;

--report printing.

The basic functions of the MP subsystem are:

--receiving data on modification plan;

--control of product warehousing;

--automatic selection of warehouse storage location;

--report printing.

Basic functions of the FC subsystem are:

--registration and control of the weight of blooms on the scales;

--control of heating process;

--control of furnace loading and unloading devices;

--monitoring of blooms in the furnaces;

--report printing.

Equipment:

--two Melcom-350-7 computers with 96 kB RAM memory;

--disc memory 2 x 1 MB;

--one PDP-11/34 computer with 64 kB RAM memory;

--disc memory 4.8 MB;

--standard peripheral equipment: tape readers and punches, card readers, teleprinters, line printer;

--equipment for communication with operators: monitor screens with keyboards, digital screens with keyboards, card readers, message printers, operator consoles;

--industrial data channel: 1280 static digital inputs and 1160 outputs; 464 interrupt inputs; 32 analog outputs and 3 variable digital inputs.

The design and software by Melco (Japan), Stein Surface (France), Biprohut and Nowotko Metal Works.

The FC subsystem has been in operation since 1980, although without the control of charge heating process. (Implementation by Stein Surface and Nowotko Metal Works.) The TR and MP subsystems are under development (by Elektromontaz Enterprises and Nowotko Metal Works).

Katowice Metal Works - Semifinished Product Rolling Mill Department

System for Control of Billet Cutting Process

The system controls the operation of the mobile cutting frame of the continous-action billet rolling mill.

The basic system functions are:

--billet monitoring;

--strip measurement and length calculation;

--optimizing billet cutting and shear control;

--report printing.

Equipment:

--ADT 4100 computer with 16 kB RAM memory;

--standard peripheral equipment: tape punch and reader, printer;

--industrial data channel.

Design and software by Skoda Enterprises (Czechoslovakia). Development and implementation by Katowice Metal Works. The system has been in operation since 1977.

Currently, the Katowice Metal Works are completing work on transferring the software to the PDP-11/35 computer with 64 kB RAM memory, which will replace the equipment currently in use.

Katowice Metal Works - Medium Rolling Mill Department

System for Management and Control of Rolling Mill

The operation of the system involves the heating furnaces, the working rolling mill, the four-unit shears, the stacker and the product warehouse. The functions are divided between four interconnected computer units constituting the CS, FC, RMC and CMC subsystems.

The basic functions of CS subsystem are:
--invoice and lots control;
--strip monitoring;
--display of cutting instructions;
--stacker control;
--management of product warehousing;
--management of cylinder combinations;
--preparation of general reports.

Basic functions of the FC subsystem are:
--billet waste control and registration;
--control of billet heating process;
--control of drives;
--billet monitoring in the furnace;
--printing furnace reports.

The basic functions of the RMC subsystem are:
--control of cylinder setting;
--control of manipulator setting;
--control of rolling speed;
--control of flow sequence;
--engineering and failure reports.

The basic functions of the CMC subsystem are:
--optimum cutting of strips by four-unit cutter;
--initial sorting of orders;
--report printing.

Equipment:
--three PDP 11/35 computers with 160 kB and 2 x 128 kB RAM memories;
--3 x 2.4 MB disc memory and magnetic cassette memory;
--one PDP-11/05 computer with 64 kB RAM memory;
--2.4 MB disc memory and magnetic cassette memory;
--standard peripheral equipment: tape punch and reader, teleprinter;
--equipment for communication with operators: monitor screen with keyboard, digital screen with keyboard, message printers, operator consoles;

—industrial data channel (static digital inputs and ouputs, interrupt inputs, variable inputs, analog inputs).

The design, software and implementation by CEM (France), Stein Surface (France), Biprohut and Katowice Metal Works.

The system has been in operation since 1978, although without the control of charge heating process.

The CS subsystem has been introduced on a limited scale.

Katowice Metal Works - Department of Large Rolling Mills

System for Control and Management of Rolling Mills

The system operation encompasses the initial reversing frames and hot cutters. The system is divided between two computers units constituting the RMC1 and RMC2 subsystems.

The basic functions of the RMC1 subsystem are:

—similar to RMC subsystem for medium-sized rolling mill.

The basic functions of the RMC2 subsystem are:

—optimizing the strip cutting on hot cutters;

—initial order computations;

—marker control;

—report preparation;

—control of rolling process in reversing mills (similar to RMC subsystem of medium-sized rolling mill).

Equipment:

—two PDP-11/35 computers with 160 kB and 128 kB RAM memories;

—disc memory 2 x 2.4 MB and magnetic cassette memory;

—standard peripheral equipment: tape punch and reader, teleprinter;

—equipment for communication with operators: monitor screens with keyboards, message printers and operator consoles;

—industrial data channels (static digital inputs and outputs, interrupt inputs, variable inputs and analog inputs).

The design and software by CEM (France), Biprohut and Katowice Metal Works.

The RMC1 subsystem was put into operation by the Katowice Metal Works and has been working since 1979. Expansion of a modified RMC2 subsystem has reached an advanced stage of development (Katowice Metal Works and Biprohut).

Batory Metal Works - Thick Sheet Rolling Mill

System for Control of the Rolling Process

The system embraces the furnaces and rolling mills.

The basic functions are:

--receiving data on billets and sheets to be made;

--monitoring the strips in the area of system operation;

--predictive-adaptive calculation of the optimal rolling program to ensure the production of required sheet parameters with minimal scrap;

--correcting the calculated programs based on data of measurements and previous scrap quantities;

--direct control of main rolling mill drive and setting of cylinders, self-flows and manipulators;

--report printing.

Equipment:

--Honeywell HS-PAC 4010 computer with 24 kiloword RAM memory;

--128 kiloword drum memory;

--standard peripheral equipment;

--industrial data channels with digital and analog inputs and outputs.

The system receives signals from 17 sensors and controls seven drives.

The design and software by General Electric (United States), Batory Metal Works and Biprohut. Implementation by Batory Metal Works and Biprohut.

The system has been in operation since 1977.

Development Prospects

The designers and users of computer systems for control of industrial processes are currently engaged in the following activities:

--procurement and use of computer equipment mainly by way of capital investment that has been suspended or delayed;

--the use of domestic peripheral devices and other subassemblies in combination with systems imported from the hard currency payment sphere;

--introduction of domestic microcomputers and program control units to control new modernized metallurgy systems.

Using the computer systems for other purposes than their original design is difficult and expensive, mainly because the controlled object has to be

adapted to the requirements of the system, and it is necessary to restructure the equipment configuration and develop new application software. Yet, it is necessary to utilize the equipment that is currently out of use to preclude depreciation and technological obsolescence.

In the systems that have been in operation for a number of years, some of the peripheral devices (such as printers, punches, tape and card readers) have been largely worn. Importing spare components from the hard currency payment sphere is difficult. It is necessary to apply in these systems domestic equipment or units imported from CEMA nations. The technological solution is in most cases feasible. Delays in delivery, however, present problems.

Disc and drum memories are also components which are subject to wear and tear and yet are difficult to replace by units available from socialist countries.

In the 1970's, after digital technology was introduced for automation of industrial processes, there was a certain discrepancy of technology between complex systems for control of entire objects implemented on the basis of expensive computer hardware and the conventional systems that made use of local control means based on analog regulators and relays. The discrepancy was a result of the production profile of the electronics industry prevailing at that time and can be eliminated through advances in microelectronics and availability of inexpensive microprocessors, memories and terminals.

Large-scale application of microprocessors to automate industrial equipment and processes is expected to bring about major philosophical changes in the approach to industrial control systems. This is indicated by the following tendencies in new technological applications:

(a) microcomputer systems for control of objects where mainframe computers or minicomputers would be too expensive;

(b) use of digital programmed control units to perform functions of automation;

(c) execution of the functions of analog systems by means of digital regulators;

(d) microprocessors built into measurement instruments, operator and other equipment, increasing the "intelligence" of these objects and also often modifying the principles of their operation.

Activities of Poland's electronics industry give grounds for the hope that systems will soon be built from domestic microprocessors and memory and input/output units. Even today, Polish microcomputer systems are available which are partly based on imported elements (Mera 60, Mera 80, Mikro 80, Elwro 80) and programmable digital control units (Intelster PC-4K, Compact).

If facilities for programming and implementation are provided together with this equipment, a real chance will be given to large-scale application of microcomputer technology in Polish metallurgy.

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